Habitat Use and Connectivity of Sub-adult Fishes at Multiple Spatial Scales within an Estuarine Seascape

Uso del Hábitat y la Conectividad de Peces Subadultos a Múltiples Escalas Espaciales en un Estuario Marino

Utilisation de l'Habitat et de la Connectivité des Poissons Subadultes à des Échelles Spatiales Multiples au sein d'un Paysage Maritime Estuaire

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EXTENDED ABSTRACT

Estuaries are highly productive ecosystems containing several habitats many of which are widely considered to serve as important nursery habitats (e.g. seagrasses, salt marsh) for many species of juvenile fishes and invertebrates. While the importance of estuarine habitats to early juvenile stages has been widely documented (Rooker et al. 1998, Minello et al. 2003) relatively little is known about habitat use during late juvenile and sub-adult life stages. Since many fish species remain in estuarine habitats throughout more mobile late juvenile and sub-adult stages before reaching sexual maturity, an improved understanding of habitat use and connectivity at these life stages is needed to effectively prioritize the conservation of essential fish habitat. Here we utilize acoustic telemetry to examine species-specific and ontogenetic differences in habitat use of two economically important fishes (red drum *Sciaenops ocellatus* and southern flounder *Paralichthys lethostigma*) at multiple spatial scales within a model estuarine seascape (Christmas Bay, Texas USA).

Acoustic telemetry arrays were deployed at two spatial scales in Christmas Bay, Texas, a small sub-bay of the larger Galveston Bay containing multiple habitat types (two species of seagrass, oyster reef, marsh, tidal creeks). A VR2W positioning system (VPS) was used to monitor habitat-scale (m) movements and connectivity, while a larger grid of VR2W receivers was deployed throughout the bay to examine habitat use at the bay-scale. Age-1 (n = 8) and age-2 red drum (n = 6) as well as age-1 southern flounder (n = 8) were collected and tagged with Vemco V9 acoustic transmitters (69kHz) and then rereleased into Christmas Bay simultaneously on January 15, 2012. Fish movements were monitored within the VPS array (habitat scale) for one month, while movements within the larger array (bay-scale) were recorded through March 31, 2012 . Euclidean distance based analysis (EDA, Conner et al. 2003) was used to determine and compare habitat associations of each species/age-class combination within the VPS array (habitat scale). Movement rates (meters/minute) for each group were calculated from consecutive fish positions within the VPS array. At the bay scale, daily centers of activity space (COA) were calculated (Simpfendorfer et al. 2002) for each fish and used to create kernel utilization distributions (KUD). Percent habitat composition and measures of complexity (total edge, patch density, patch richness) were calculated for each fish's core use area (defined here as 50% of the KUD) and used to compare large scale habitat associations among species/age-class combinations.

Over 75,000 detections were recorded within the bay scale array, and over 9,000 positions were determined by the VPS (habitat scale). At the bay-scale there was a difference in the composition and complexity of core use areas among species from open bay areas with low patch density used primarily by southern flounder to more channelized marsh habitats (tidal creek dominated) used primarily by red drum (Figure 1A). Ontogenetic differences in bay-scale habitat use were demonstrated with habitat complexity (patch richness and patch density) increasing from age-1 to age-1 red drum (Figure 1B). Within the VPS array, habitat use differed between species, but did not differ among age classes of red drum. While both species were found closely associated with turtle grass habitats, red drum were more commonly associated sand habitat, while southern flounder were more commonly associated with marsh habitat. All species/age-class combinations were found disproportionately closer to edge (the confluence of any two habitats) than would be expected, indicating at the habitat level both species are strongly associated with areas of habitat convergence. Movement rates for both species were positively linked to temperature change (increased speed at increased temperatures), however red drum speeds consistently exceeded those of southern flounder across all temperatures. Results suggest that habitat use varies among estuarine fishery species inhabiting the same seascape and the degree of connectivity among habitats at the bay and habitat scale is also affected by environmental factors (i.e. temperature). Furthermore, since patterns of habitat use were variable between the bay and habitat scale for both species, it may be important to identify essential fish habitats at multiple spatial scales for mobile late juvenile and sub-adult fishes to better understand the importance and role of estuarine habitats as nurseries.

KEY WORDS: VPS, acoustic telemetry, EDA, red drum, southern flounder

LITERATURE CITED

Conner, L.M., M.D. Smith, and L.W. Burger. 2003. A comparison of distance-based and classification-based analyses of habitat use. *Ecology* **84**:526-531.

Minello, T.J., K.M. Able, W.P. Weinstein, and C.G. Hays. 2003. Salt marshes as nurseries for nekton: testing hypotheses on density, growth, and survival through meta-analysis. *Marine Ecology Progress Series* **246**:39-59.

Rooker, J.R., S.A. Holt, M.A. Soto, and G.J. Holt. 1998. Post-settlement patterns of habitat use by Sciaenid fishes in subtropical seagrass meadows. *Estuaries* **21**:318-327.

Simpfendorfer, C.A., M.R. Heupel, and R.e. Hueter. 2002. Estimation of short-term centers of activity from an array of omnidirectional hydrophones, and its use in studying animal movements. *Canadian Journal of Fisheries and Aquatic Science* **59**:23-32.
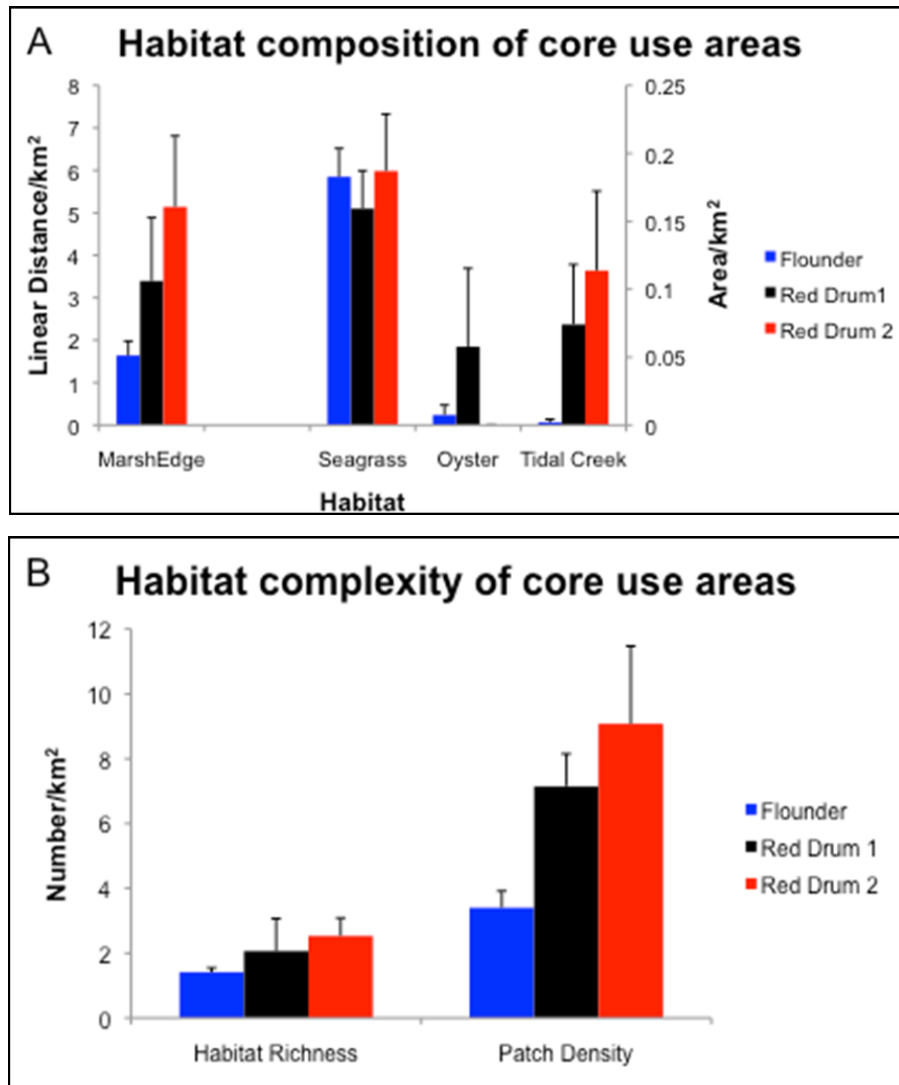
Figure 1. Mean relative habitat composition (panel A) and complexity (panel B) of core use areas (50% KUD) for southern flounder, age-1 red drum, and age-2 red drum.